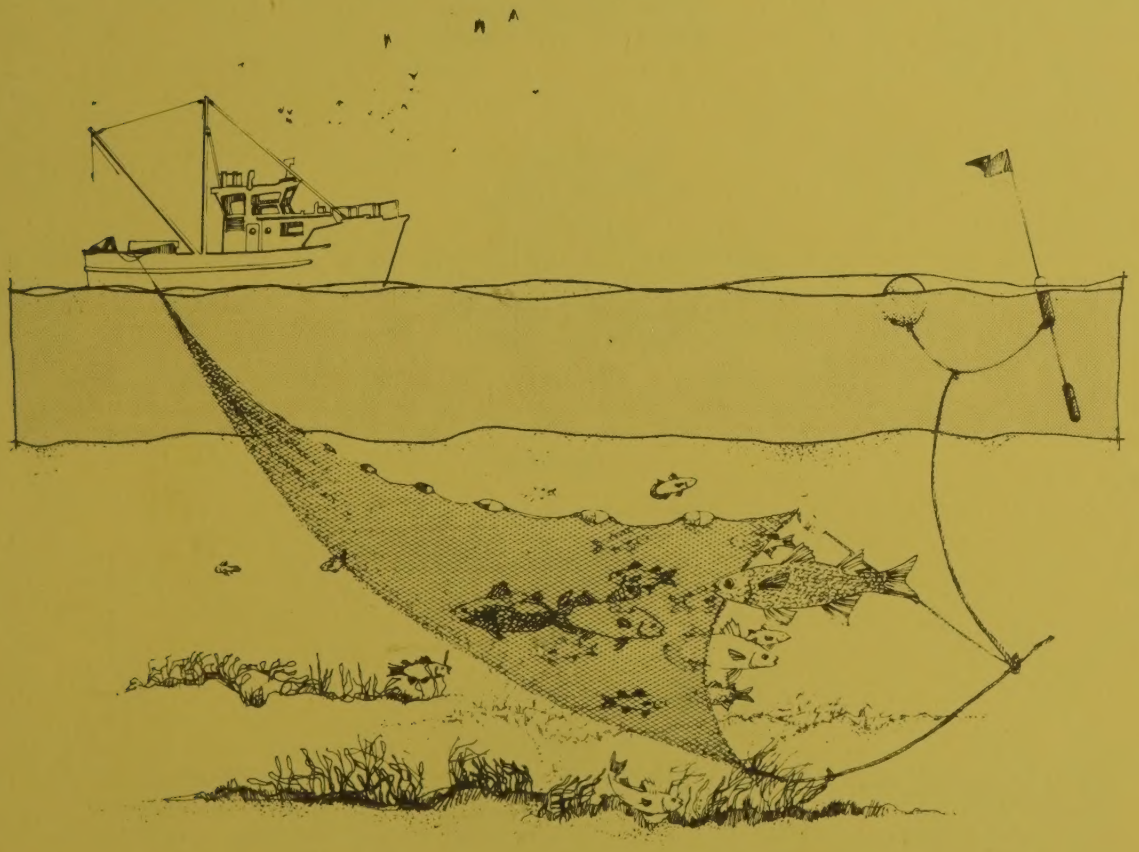
Biological Report 82(11.39)
May 1985

TR EL-82-4

Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (South Florida)

WHITE MULLET



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This is one of the first reports to be published in the new "Biological Report" series. This technical report series, published by the Research and Development branch of the U.S. Fish and Wildlife Service, replaces the "FWS/OBS" series published from 1976 to September 1984. The Biological Report series is designed for the rapid publication of reports with an application orientation, and it continues the focus of the FWS/OBS series on resource management issues and fish and wildlife needs.

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Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (South Florida)

WHITE MULLET

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Waterways Experiment Station
U.S. Army Corps of Engineers
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PREFACE

This species profile is one of a series on coastal aquatic organisms, principally fish, of sport, commercial, or ecological importance. The profiles are designed to provide coastal managers, engineers, and biologists with a brief comprehensive sketch of the biological characteristics and environmental requirements of the species and to describe how populations of the species may be expected to react to environmental changes caused by coastal development. Each profile has sections on taxonomy, life history, ecological role, environmental requirements, and economic importance, if applicable. A three-ring binder is used for this series so that new profiles can be added as they are prepared. This project is jointly planned and financed by the U.S. Army Corps of Engineers and the U.S. Fish and Wildlife Service.

Suggestions or questions regarding this report should be directed to one of the following addresses.

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CONVERSION TABLE

Metric to U.S. Customary

Multiply	By	To Obtain
millimeters (mm)	0.03937	inches
centimeters (cm)	0.3937	inches
meters (m)	3.281	feet
kilometers (km)	0.6214	miles
square meters (m^2)	10.76	square feet
square kilometers (km^2)	0.3861	square miles
hectares (ha)	2.471	acres
liters (l)	0.2642	gallons
cubic meters (m^3)	35.31	cubic feet
cubic meters	0.0008110	acre-feet
milligrams (mg)	0.00003527	ounces
grams (g)	0.03527	ounces
kilograms (kg)	2.205	pounds
metric tons (t)	2205.0	pounds
metric tons	1.102	short tons
kilocalories (kcal)	3.968	British thermal units
Celsius degrees	1.8(°C) + 32	Fahrenheit degrees

U.S. Customary to Metric

inches	25.40	millimeters
inches	2.54	centimeters
feet (ft)	0.3048	meters
fathoms	1.829	meters
miles (mi)	1.609	kilometers
nautical miles (nmi)	1.852	kilometers
square feet (ft^2)	0.0929	square meters
acres	0.4047	hectares
square miles (mi^2)	2.590	square kilometers
gallons (gal)	3.785	liters
cubic feet (ft^3)	0.02831	cubic meters
acre-feet	1233.0	cubic meters
ounces (oz)	28.35	grams
pounds (lb)	0.4536	kilograms
short tons (ton)	0.9072	metric tons
British thermal units (Btu)	0.2520	kilocalories
Fahrenheit degrees	0.5556(°F - 32)	Celsius degrees

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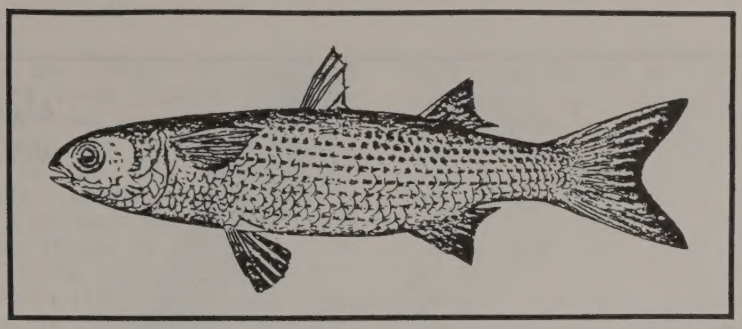

Figure 1. White mullet.

WHITE MULLET

NOMENCLATURE/TAXONOMY/RANGE

Scientific name . . . . . Mugil curema Valenciennes, 1836
Preferred common name . . White mullet (Figure 1)
Other common names . . . Silver mullet
Class . . . . . Osteichthyes
Order . . . . . Perciformes
Family . . . . . Mugilidae

Geographic range: Atlantic and Eastern Pacific; in the Western Atlantic from Canada to Uruguay; adults rare north of Florida (Figure 2).

MORPHOLOGY/IDENTIFICATION AIDS

Dorsal fin IV + I spines, 8 rays; anal fin III spines, 9 rays (II, 10 in juveniles). Lateral line scale count 33-39 (usually 38-39). Anal and second dorsal fins scaled; origin of first dorsal fin midway between middle of caudal base and tip of snout; caudal fin often has dark posterior border; sides of body silvery without conspicuous stripes; back blue or olive; gold spot on opercle usually apparent; adipose eyelid present (Hoese and Moore 1977; Rivas 1980).

The white mullet and striped mullet are easily separated taxonomically. The white mullet has 9 anal rays and the pectoral fin lengths are 77%-84% of the head lengths; the striped mullet has 8 anal rays and the pectoral fins are 66%-74% of the head length.

REASON FOR INCLUSION IN SERIES

The white mullet, the second most common species of the family Mugilidae in Florida waters, constitutes a measurable proportion of the commercial mullet catch, and is a popular baitfish in the sport fishery for billfish. Because white mullet feed primarily on living and dead vegetable matter, as do the more numerous striped mullet (Mugil cephalus), they are ecologically important as primary consumers in the food chains of coastal and estuarine waters.

LIFE HISTORY

Spawning

In 1954, a school of thousands of spawning white mullet was observed

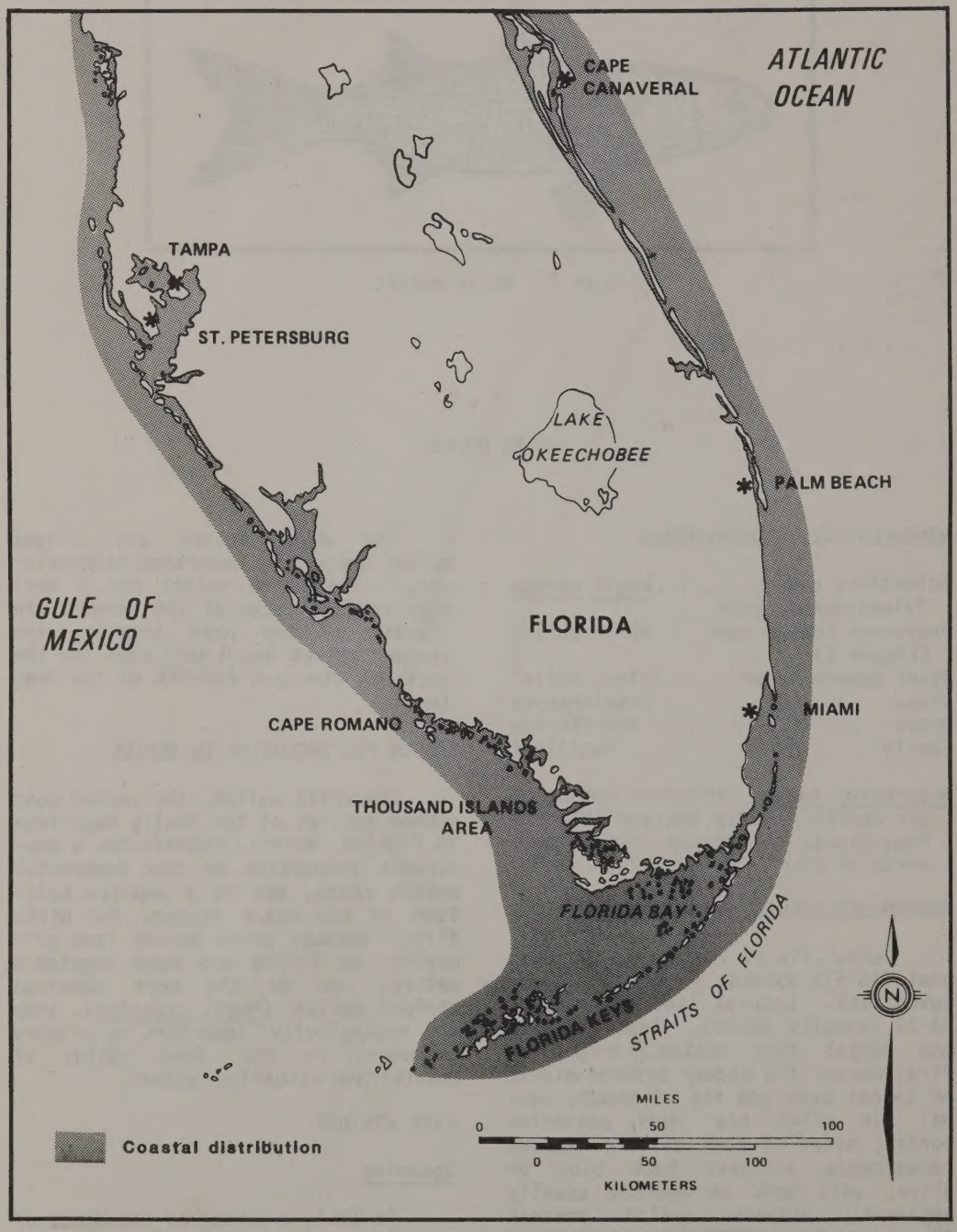

Figure 2. Distribution of white mullet in the South Florida Region.

at night on the surface in about 60 m of water off south Florida (Anderson 1957). Eggs and early larvae were collected near the surface from that depth out to the axis of the Gulf Stream and northward to North Carolina. Eggs have been collected in Biscayne Bay (Houde et al. 1976). On the basis of the distribution of larvae, Anderson (1957) concluded that white mullet in Florida spawn primarily from April through June (extremes, March through September). Based on gonad development, Mefford (1955) assumed that white mullet spawn from April through June. In the Gulf of Mexico off Texas, Moore (1974) collected white mullet with gonads in post-spawning condition in late spring and early fall, but not in the summer, and suggested the possibility of an interrupted spawning season or two populations that spawn at different times. Two spawning seasons, summer and winter, were reported for Cuban waters (Alvarez-Lajonchere 1976).

Unfertilized white mullet eggs average 0.82 mm in diameter. The shell has a finely etched or scratched appearance, the yolk is an opaque mass with little or no perivitelline space, and there is a pale yellow oil globule averaging 0.03 mm in diameter atop the yolk mass. Soon after fertilization the egg increases to an average diameter of 0.90 mm. Dimensions of the egg and oil globule are relatively constant until the egg hatches 40-42 h after fertilization (Anderson 1957). Alvarez-Lajonchere (1976) presented the following fecundity equation for Cuban white mullet, where F = number of eggs and W = weight in grams: $F = 959.54439W - 102947.552$.

Larvae and Juveniles

Newly hatched larvae lack a mouth, fins, and eye pigment. About 32 h after hatching, when the larvae are about 2.6 mm long (all lengths are total lengths [TL] unless otherwise indicated), the pectoral fin buds begin to appear and the mouth forms. Full complements of fin rays in anal and both dorsal fins characterize larvae 5.3 mm long, and the two spines and ten rays are discernible in the anal fin of larvae about 14.5 mm long. Larvae retain the "II, 10" anal fin until about 30-40 mm long, when they may be considered juveniles; the "III, 9" anal fin is thereafter retained through maturity (Anderson 1957). Laboratory-reared fish were 36 mm long 36 days after hatching (Houde et al. 1976). Larvae begin appearing inshore along beaches and in estuaries when about 25 mm long and 28 days old (Anderson 1957). By the end of their first year, juveniles probably reach a length of 200 mm standard length (SL), and become sexually mature. Young white mullet carried north by the Gulf Stream have been reported as far north as Canada (Alvarez-Lajonchere 1976).

Juveniles enter the estuaries and live in the inner marshes for the summer of their first year; they emigrate seaward when water temperatures begin dropping in the fall. Young mullet along the Atlantic coast migrate southward to Florida or further in the fall. Juveniles become scarce along the coast of Texas after October (Moore 1974) and along Georgia's coast after mid-December (Anderson 1957). Immigrants from Georgia probably migrate to inshore waters of Florida, and the Texas mullet probably migrate to Mexican waters, where they reside until the following spring.

Adults

After their first year, white mullet are rarely collected north of Florida (Anderson 1957). Males taken from a school of spawning fish off the south Florida coast averaged 189 mm SL; females averaged 209 mm SL (Anderson 1957). A positive correlation between length and the percentage of mullet that are mature is illustrated in Figure 3. The average length of white mullet

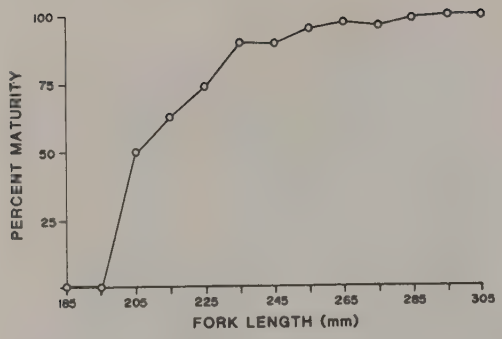

Figure 3. The cumulative percent of mature white mullet for each length group (Mefford 1955).

caught by commercial fishermen in Florida was about 250 mm SL, and the maximum was about 350 mm SL (Mefford 1955). Males in Cuban waters greatly outnumber females at lengths shorter than 31 cm FL. There were no sexual differences in the length-weight relationship (Alvarez-Lajonchere 1976). In Florida, Mefford (1955) reported a sex ratio of about 1:1. It is likely that white mullet along the gulf and Atlantic coasts are separate populations (Rivas 1980).

GROWTH CHARACTERISTICS

Using larvae and juveniles collected in Georgia by seining, Anderson (1957) estimated a growth rate of about 17 mm per month. Richards and Castagna (1976), using similar material from Virginia, estimated the growth rates to be 17.5-19.5 mm for each half-month of the summer, or more than double Anderson's value. The growth rate of 17 mm per month over 1 year appears to correspond well to the size at that age, but it is also possible for a higher summer growth rate and a much slower winter growth rate to result in the same size at 1 year. Using length-weight data from Mefford (1955) and assuming a length of 200 mm at age I, Richards and Castagna (1976) developed the following growth equations:

$$L_t = 360\ (1-e^{-0.78(t+0.06)})$$

$$W_t = 615\ (1-e^{-0.78t})^3$$

where L_t = fork length in mm, t = time in years, and W_t = weight in grams. For each of the first 5 years, the first equation yields fork lengths of 203, 288, 327, 345, and 353 mm, and the second yields weights of 98, 303, 454, 537, and 578 g. Alvarez-Lajonchere (1976), attempting to age white mullet by dorsal spine sections, estimated the following fork lengths for Cuban mullet at ages one through four, respectively: 232, 285, 333, and 364 mm. He also reported a length-weight equation of $W = 0.0330\ L^{2.738}$. The length-weight relationship of white mullet in Florida is illustrated in Figure 4.

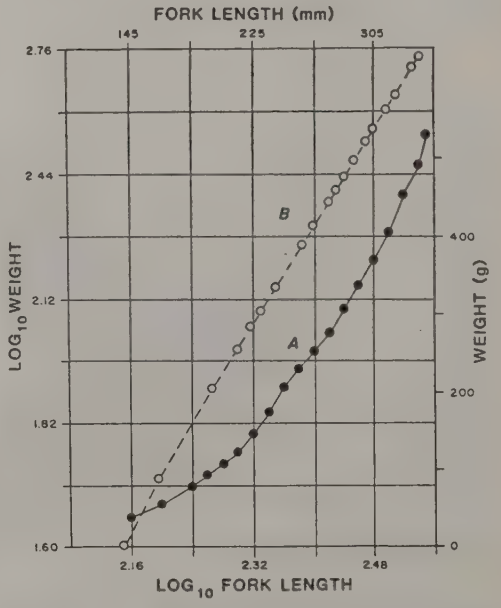

Figure 4. Length-weight relationships for white mullet in Florida. A = absolute values, B = $\log_{10}$ values (from Mefford 1955).

THE FISHERY

White mullet are not highly prized as food, but they are valuable as bait in the billfish sport fishery. Most fishermen in charter boats purchase mullet for bait, but some use castnets to catch their own.

In Florida, most of the commercial white mullet are taken by the striped mullet fishery. In years when the white mullet are unusually abundant, the catch is sorted by species; but apparently some fishermen and retailers do not always separate the two species at the market. The data for white mullet landings from 1958 to 1981 are given in Table 1.

The gears used most often to catch white mullet and striped mullet are trammel nets, gill nets, and seines. See the Species Profile for striped mullet (Mugil cephalus) for a brief description of these nets and their use. There are no regulations or closed seasons on white mullet.

Table 1. Annual landings (pounds) of white mullet in Florida, 1958-81. (1958-76 data from Florida Dep. of Natural Resources; 1977-81 data from National Marine Fishery Service.)

Year	Coast		
	East	West	Combined
1958	180,199	958,129	1,138,328
1959	147,754	669,271	817,025
1960	178,485	423,479	601,964
1961	185,145	470,441	655,586
1962	74,277	465,964	540,241
1963	59,821	664,664	724,485
1964	41,923	544,875	586,798
1965	100,848	792,282	893,130
1966	164,697	697,432	862,129
1967	218,293	1,088,584	1,306,877
1968	294,356	1,039,877	1,334,233
1969	260,486	758,277	1,018,763
1970	322,055	501,297	823,352
1971	241,532	624,664	866,196
1972	165,352	435,306	600,658
1973	197,209	609,227	806,436
1974	579,102	606,862	1,185,964
1975	311,871	531,859	843,730
1976	296,495	746,285	1,042,780
1977	141,595	524,080	665,675
1978	129,950	698,734	828,684
1979	179,022	594,289	773,311
1980	393,841	498,974	892,815
1981	378,856	282,444	661,300

ECOLOGICAL ROLE

Data on the food and feeding habits of white mullet are scarce. White and striped mullet often feed on the same food at the same times and places. Larval white and striped mullet feed and thrive on microcrustaceans. Houde et al. (1976) reported that a culture of white mullet larvae thrived on copepod nauplii and copepodites. As larvae grow, their ingestion of bottom sediments, detritus, and algae increases. Juveniles do not usually feed on microcrustaceans but juveniles (35-80 mm long TL) of both species may feed on dinoflagellates such as Kryptoperidinium sp. (Odum 1968); like adults, they rely on trituration in their gizzard-like, pyloric stomachs to break down food particles. The stomach contents of both juvenile and adult white and striped mullet in Texas were very similar, both in the items present (sediment particles, detritus, diatoms, green algae, and blue-green algae) and in the proportions of each item (Moore 1974).

Information on predation and competition that specifically concerns white mullet is scarce, but in one instance Richards and Castagna (1976) reported collecting juveniles with injuries probably sustained during attacks by predators such as weakfish (Cynoscion regalis), bluefish (Pomatomus saltatrix), and red drum (Sciaenops ocellata). In Florida, major predators of adults are piscivorous fish and birds. No evidence for interspecific competition exists.

ENVIRONMENTAL REQUIREMENTS

Temperature

White mullet have been collected at water temperatures of 19 to 36°C in Texas (Moore 1974), 20.1 to 31.5°C in Virginia (Richards and Castagna 1976), and 19.5 to 35.4°C in Florida (Kilby 1955). The species is tropically adapted (Moore 1974), and experimental evidence suggests a high (28°C or somewhat greater) optimum temperature for white mullet (Moore 1973). The decreasing water temperatures in late fall may induce juveniles to emigrate from estuaries north of Florida, but changes in photoperiod have not been ruled out as important stimuli (Anderson 1957).

Salinity

On the peninsular gulf coast of Florida, Kilby (1955) reported catching juvenile white mullet in salinities ranging from 4 to 25 ppt. In a study in Texas, white mullet adults were abundant only in salinities of 25 to 36 ppt (Moore 1974). Few enter brackish waters in the northern Gulf of Mexico. However, I have collected adult white mullet from freshwater in Crystal River, Florida (unpubl. data).

Relevant data on the effects of dissolved oxygen, substrate, depth, currents, diseases, and parasites on white mullet are sorely lacking.

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16. Abstract (Limit: 200 words)

Species profiles are literature summaries of the taxonomy, morphology, distribution, life history, biological and physical environments, and environmental requirements of coastal species of fishes and aquatic invertebrates. They are designed to assist in environmental impact assessment. The white mullet (Mugil curema) is a valuable baitfish. Adults spawn offshore, and are seldom found at low salinities. Juveniles spend the summer of their first year in estuaries. White mullet are caught with trammel nets, gill nets, and seines. About 660,000 pounds were landed in 1981. The species is adapted to tropical temperatures, with an optimum of about 28 °C.

17. Document Analysis a. Descriptors

Fishes
Estuaries
Feeding
Grow

b. Identifiers/Open-Ended Terms

White mullet
Mugil curema
Salinity requirements
Temperature requirements
Life history
Spawning
Habitat requirements

c. COSATI Field/Group

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